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Productivity improvement though OEE measurement: A TPM case study for meat processing plant in Australia

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ABSTRACT

Fluctuating demands and increased competition in Australia and Asian countries have been putting more pressure on plants for packaged meat products in Australia. Total Productive Maintenance (TPM) was seen a solution and is currently being implemented within a major meat processing facility in Melbourne, Australia for achieving high Overall Equipment Effectiveness (OEE). Concerns were raised by board of directors due to OEE targets not meant. TPM was initially applied in key areas of the business, thermoforming and packaging for reducing wastes and further enhancing productivity and quality. It is now being rolled out to other sections of the plant. Data collected from fifty-two weeks of production has been analysed and recommendations made to achieve OEE targets for the R145 production line. Risk based maintenance was applied to control adverse effects of packaging quality which significantly influences shelf life. Shelf life of a modified atmosphere packaged product assures safety for consumption of meat products by consumers. Risk based maintenance considered asset failure probabilities, impacts on quality and availability of spare parts. Reliability Centred Maintenance (RCM) resulted in a Risk score for each maintenance activity and as a component was used for TPM program. Findings from this study have been passed on to the meat processing facility for implementation in the entire plant.

Keywords
TPM, Risk Based Maintenance, OEE, RCM

1. INTRODUCTION

The prevailing dynamic global business scenario resulted in demands for novel approaches by meat processing plants in Australia to remain competitive. Some of the key objectives of this highly regulated industry are; retaining values of capital-intensive assets and reducing failures to achieve higher productivity. Total productive maintenance (TPM) was originally conceived in the United States as preventive maintenance (PM). In 1950, Seiji Nakajima considered as pioneer of TPM first modified and enhanced to fit it to the Japanese industrial culture. TPM is productive maintenance carried out by all the employees through small group activities [1]. TPM is also known now as an advanced manufacturing technique that focuses on maximizing the overall equipment effectiveness of any asset used in the production of goods and services [2]. These techniques have been used by various organizations now to increase business performance [3].

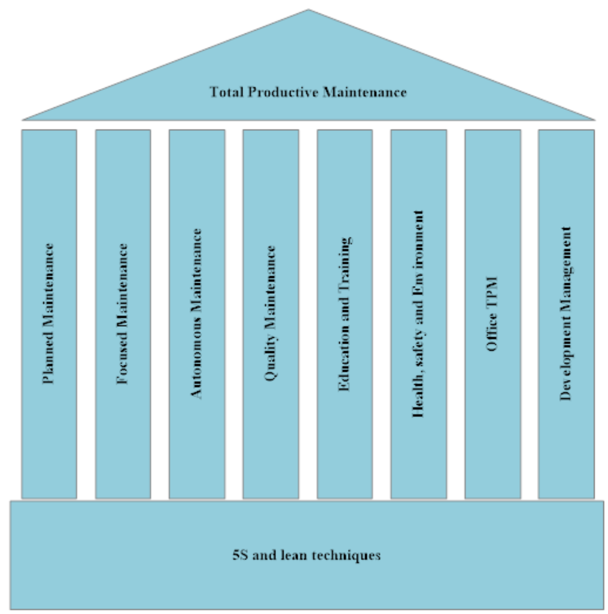

Figure 1. TPM pillars [4].

Research findings have been used for improving equipment effectiveness, eliminating breakdowns, reducing costs and promoting autonomous maintenance. Maintenance performance and its measure is an important part of reducing losses and productivity improvement [5]. Reliability improvement programmes have been used in various organizations for design, configuration changes and maintenance intervals [6]. TPM has evolved into 8 major pillars [7] and now use whole organization approach for achieving high OEE.

The overall equipment effectiveness (OEE) is an index now used in the manufacturing industry to calculate the effectiveness of a production system or its parts. The index was presented as a metric in TPM by [1] that takes into consideration the six big losses that affect the productivity. Equipment failure, setup, and adjustments are related to the downtimes and expressed in terms of availability. Idling and minor stoppages, together with reduced speed, are related to speed losses and expressed in terms of the performance rate [8]. Some researchers claim that the availability metric is influenced by factors beyond the equipment itself, such as operators, facilities, the availability of input materials, scheduling requirements, etc. They argue, OEE metric reflects the integrated equipment system and not the equipment itself [9]. Others pointed out that the OEE does not take into consideration all the factors that reduce the availability, such as the planned downtime and the lack of material and labour [10]. However, majority of researchers agree that OEE evaluates how effectively a manufacturing operation is utilized and is expressed well in terms of Performance, Availability and Quality. Performance is measured in terms of whether plant is operated as per expected speed, reduced speed or with minor stops. Availability is measured in terms of breakdowns and product changeovers. Quality is measured in terms of acceptance and rejects in start-up, during production runs and customer returns.

OEE is now considered as an indicator of the health and performance of assets and productivity. Six big losses monitored and measured through OEE are [11]:

1. Breakdowns
2. Setup and Adjustment
3. Small stops
4. Slow running
5. Start-up Defects
6. Production Defects

Effectiveness (OEE) is widely expressed as a function of availability (ã), Performance (P) and quality (Q).

$$OEE = \tilde{a} \times P \times Q \qquad \text{[Eq 1]}$$

2. METHODOLOGY

Historical OEE figures for two thermoforming packaging machines of the Australian meat processing plant have been compiled for over a period (July 2016 to Jun 2018) and analysed in Figure 2.

Actual – Kg's of finished goods (exclude rejects)

Ideal – Reflects how many kg's could be produced within the operating time based in ideal run rate. DTime – Downtime, OpTime – Operating Time. Figure2. Noted decrease in OEE for R145 line from Jul 16 to April 18. Root cause related to R145 has been further analysed. OEE Calculation (Jul 16) are as follow:

- $$Availability, \tilde{a} = \frac{Operating\ Time}{(Downtime + Operating\ Time)}$$
  $$\tilde{a} = \frac{231.75}{46.82 + 231.75} = 0.8319$$
- $$Performance * Quality = \frac{Actual}{Ideal} = \frac{261637.00}{321456.29}$$

$$OEE = \tilde{a} \times P \times Q \qquad OEE = 0.8319 * 0.8139 = 0.6771$$

R-145

Date	Actual	Ideal	DTime	OpTime	OEE
Jul-16	261637	321456	47	232	67.71%
Aug-16	215596	248085	40	206	72.86%
Sep-16	239696	301554	61	244	63.66%
Oct-16	241525	301055	64	231	62.77%
Nov-16	231360	331484	60	241	55.87%
Dec-16	225288	314323	44	216	59.67%
Jan-17	211618	293030	53	205	57.32%
Feb-17	157544	197415	33	142	64.58%
Mar-17	195937	254261	44	179	61.90%
Apr-17	200772	290587	36	195	58.41%
May-17	280666	391662	53	254	59.27%
Jun-17	243574	317851	51	213	61.78%
Jul-17	259195	348880	55	217	59.23%
Aug-17	331389	428211	67	283	62.65%
Sep-17	357705	471218	84	312	59.85%
Oct-17	357015	508118	83	330	56.13%
Nov-17	271887	399445	61	254	54.90%
Dec-17	231582	361538	66	237	50.07%
Jan-18	259895	392902	58	257	53.96%
Feb-18	200035	276680	48	177	56.96%
Mar-18	227557	336623	60	229	53.55%
Apr-18	221091	308654	49	213	58.27%
May-18	288868	348479	53	231	67.36%
Jun-18	154535	206175	31	151	62.26%

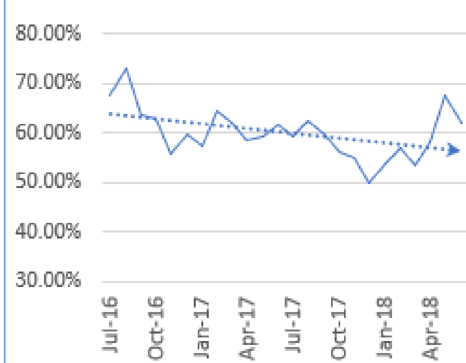

Figure 2. OEE data July 2016 to Jun 2018.

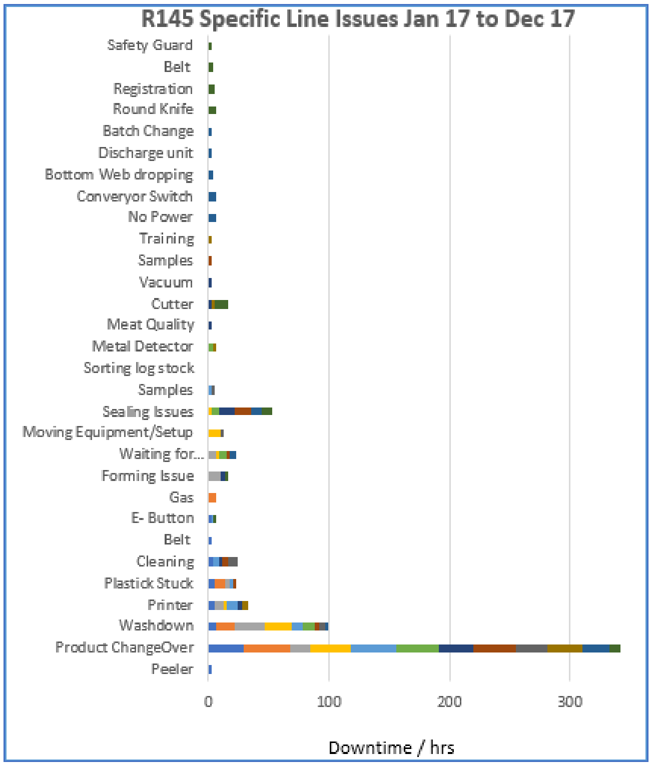

Figure 3. Specific line issues from Jan 17 to Dec 17.

3. DISCUSSIONS AND RESULTS

Trending of historical data for R145 machine indicates that the major contributors to downtime were:

- Product Changeover
- Washdown/Cleaning
- Sealing and other thermoforming issues

In order to improve the productivity (OEE level), downtime was critically examined and following remedial measures were proposed:

Product Change Over

To cater for different types of packs produced mould, cutter and hence configuration changes were required with R145. Change-Overs were regarded as non-value-added activities and was a major contributor to low OEE. SMED was applied in 4 stages [12]:

1. Preliminary Stage: Internal and External Setups.
2. Separate Internal and External Setup
3. Convert Internal Setup to External Setup
4. Streamline both Internal and External setup

For this company, SMED was successful to one of its line (R530A) that was optimized in March 2016.

Results of optimization [12]:

- The average change over time for R530A on a 6-die format 58 mins.
- Stage 3 SMED brought the changeover time of thermoformer (51 min)
- Stage 4 SMED reduced this further to 42 min.
- A total reduction of 16 mins

Washdown/Cleaning

Food Industry in Australia has strict regulations concerning cleaning and sanitation. Downtime allocated due to washdown does not include pre-operational checks. A wash-down procedure is in place mainly to eliminate cross contamination and this is completed to specified schedules and standards. Keeping wash-down to minimum levels will increase OEE as per Eq1. No immediate change will be brought to this process due to the complexity of the process linked to regulatory requirements.

Sealing and other thermoforming issues

Changes to current maintenance strategy can have an impact on modified atmosphere pack quality and hence food safety. Reliability Centered Maintenance (RCM) and TPM integrated together will lead to several benefits [13]. In this context, RCM has been applied to R145 to establish its maintenance requirements in its present operational context. RCM worksheets are given below:

Table 1. RCM Worksheet Basic Machine

System	Thermoformer	System Number	R145	Date: 01/04/2019
Sub-System	Basic Machine	Sub-System Number	N/A	Conducted by: Vickram Chundhoo
Function	**Functional Failure**	**Failure Mode**	**Failure Effect**	**Criticality**
Cooling water system	Unable to cool	Water valve blocked Supply cut off	No cooling in forming mould. Affects shape of pack	2
Main Valve Air Supply	Unable to feed pneumatic components	Supply cut off Inlet valve defective	Machine fault with an error	3
Reel brake lifting unit	Unable to brake web	Brake pad defective Air supply cut off	Improper forming. Affects shape of formed tray	1
Chain Cleaning Lubrication	Unable to clean and lube chain	Lube valve defective Lube brush contaminated	Gripper Chain seizure or breakage	1
Register Mark Control	Unable to read printed top web	Photo eye defective	Mis-alignment of top web.	1

Table 2. RCM Worksheet Product Loading

System	Thermoformer	System Number	R145	Date: 01/04/2019
Sub-System	Product Loading	Sub-System Number	N/A	Conducted by: Vickram Chundhoo
Function	**Functional Failure**	**Failure Mode**	**Failure Effect**	**Criticality**
Filling Station (Manual)	Failure to fill right amount	Weight scale faulty	Affect net weight of product	2
Pack Lowering (Manual)	Failure to setup right depth	Wrong forming plates inserted	Incorrect Sealing	2
Leak Check (Manual)	Failure to detect a formed pack leak	Incorrect plates	Affect shelf life of the product	1
Loading Check (Manual)	Failure to check loading	Seal contamination	Affect shelf life of the product	1
Transport	Unable to transport web	Chain seizure	Machine stoppage	1

Table 3. RCM Worksheet Forming Station

System	Thermoformer	System Number	R145	Date: 01/04/2019
Sub-System	Forming Station	Sub-System Number	N/A	Conducted by: Vickram Chundhoo

Function	Functional Failure	Failure Mode	Failure Effect	Criticality
Die Lifting	Fail to lift	Solenoid valve faulty Lifting guide rods defective	Improper forming. Machine fault with an error	4
Heating	Unable to pre-heat forming die	Defective heating elements Faulty contactor	Machine fault with an error when temperature	3
Forming	Unable to form packs	Incorrect adjustments Forming plates overheated	Improper forming. Affects shape of formed tray	2
Plug	Unable to clean and lube chain	Lube valve defective Lube brush contaminated	Gripper Chain seizure or breakage	1
Ventilation	Fail to ventilate	Vent valve defective	Forming gasket damage. R145 fault with an error	3

Table 4. RCM Worksheet Sealing Station

System	Thermoformer	System Number	R145	Date: 01/04/2019
Sub-System	Sealing Station	Sub-System Number	N/A	Conducted by: Vickram Chundhoo

Function	Functional Failure	Failure Mode	Failure Effect	Criticality
Die Lifting	Fail to lift	Solenoid valve faulty Lifting guide rods defective	Improper sealing. Machine fault with an error	4
Evacuation	Unable to evacuate	Evacuation pins blocked Evac oring damage	Improper vaccuming. R145 fault with an error	4
Vacuum Supply	Unable to provide vacuum supply	Vacuum pump faulty Vaccum valve defective Vaccum hose leak	Improper vaccuming. R145 fault with an error	4
Ventilation	Fail to ventilate	Vent valve defective	Sealing gasket damage. R145 fault with an error	3
Sealing	Failure to provde adequate sealing	Seal plate blocked Heating plate defective Teflon coating damage	Slow leak in packaging. Could lead to bacterial and product recall	1

Table 5. RCM Worksheet Sealing/Printing

System	Thermoformer	System Number	R145	Date: 01/04/2019
Sub-System	Sealing /Printing Station	Sub-System Number	N/A	Conducted by: Vickram Chundhoo

Function	Functional Failure	Failure Mode	Failure Effect	Criticality
Pre/Post Sealing evacuation	Unable to evacuate	Evacuation pins blocked	Improper vaccuming. R145 fault with an error	4
Pre/Post Sealing ventialtion	Fail to ventilate	Vent valve defective	Sealing gasket damage. R145 fault with an error	3
Pre/Post Sealing/sealing	Failure to provde adequate sealing	Seal plate blocked Heating plate defective Teflon coating damage	Slow leak in packaging. Could lead to bacterial and product recall	1
Multiprint	Misprint	Print Head defective Print ribbon break	Wrong use by date. Could lead to product recall	2

Table 6. RCM worksheet cutting station

System	Thermoformer	System Numb	R145	Date: 01/04/2019
Sub-System	Cutting Unit	Sub-System N	N/A	Conducted by: Vickram Chundhoo

Function	Functional Failure	Failure Mode	Failure Effect	Criticality
Cross Cutting, Top Lifting	Unable to lift	Lifting Cylinder defective Lifting guide rods defective	No pack seperation	3
Cross Cutting, Bottom Lifting	Unable to lift	Lifting Cylinder defective Lifting guide rods defective	No pack seperation	3
Cross Cutting, Cutting	Unable to cut	Cutting knife worn out Drive motor defective	No pack seperation	3
Punching, slitting	Unable to cut	Cutting knife worn out	No pack seperation	3
Longitudinal Cutting	Unable to cut	Cutting knife worn out	No pack seperation	3
Shape cutting, Lifting	Unable to cut	Cutting knife worn out	No pack seperation	3
Shape cutting, cutting	Unable to cut	Cutting knife worn out	No pack seperation	3

Criticality matrix is referenced from [14]. A qualitative approach has been adopted as per criticality matrix and failure which fall in criticality value 3 and beyond was not subjected to the RCM decision. The RCM logic is developed based on task allocation and a flowchart is created [14]. The maintenance options from the RCM logic was broken down into two sections namely; proactive task and default actions.

Table 7. Result of RCM logic decision

Proactive	Default
Schedule rep	Failure - finding
Schedule rest	redesign
On-condition	Run to failure

Before a specific task is selected, it was checked that it should reduce the consequences of the associated failure mode to an extent which is approved by the business. Two issues which were considered are: Age of asset against probability of failure and what happens once a failure occurs? As per the RCM worksheets, failed items such as sealing gaskets, valve seats and O-ring which are subjected to direct contact with the product, environment, gas and cooling water were recommended for replacements on a 6 monthly basis as specified by OEM. Other items such as sealing dies, forming plates were monitored for deterioration. The aim was to generate the best return by implementation of a total productive maintenance and condition monitoring program as per Table 8.

Table 8. TPM plan for R145

Service Interval	Service Task	Who
8 hr / Daily		
Entire Machine	Visual Inspection	Maintenance
Entire Machine	Alkaline Cleanng and disinfection	Operator
Basic setting	Checking, adjusting	Maintenance
Vacuum pump	Checking oil level, refilling	Maintenance
Vacuum pump	Checking the oil colour	Maintenance
Film holders	Visual inspection	Maintenance
Film holders	Clean	Maintenance
Film transport chains	Blow out automatically	Maintenance
Film transport chains	Lubriacte with oil	Maintenance
Forming and Sealin Dies	Check heating plates	Maintenance
Cutting Unit	Clean	Maintenance
Cutting Unit	Apply anti-corrosion agents	Maintenance
Photo scanning heads	Clean optical components	Operator
Sensors	Clean optical components	Operator
Suction unit	Visual Inspection	Maintenance
Multiprint printer	Clean printing blocks	Operator

Service Interval	Service Task	Who
200 hr / Monthly		
Lifting unit- individual lubrication	Lubrication	Maintenance
Central lubrication of lifting unit	Lubrication	Maintenance
Register Mark control	Clean the film brake	Maintenance
Micro-filter for compressed air	Visual inspection	Maintenance
Discharge conveyor	Ajust friction brake	Maintenance

Service Interval	Service Task	Who
As needed		
Entire Machine	Intensive Cleaning	Operator
Entire Machine	Decalcifying	Operator
Lifting Unit - spindle	Lubricate (every 2500 hrs)	Maintenance
Micro-filter for compressed air	Replacement	Maintenance
Glass jar separator	Clean	Maintenance
Suction Unit	Replace Filter cartridge	Maintenance

Service Interval	Service Task	Who
50 hr / Weekly		
Entire Machine	Acidic cleanng and disinfection	Operator
Connections	Visual inspection	Maintenance
Vacuum Pump	Visual inspection	Maintenance
Automatic chain lubrication	Checking oil level, refilling	Maintenance
Lifting unit - tie rods and guide rods	Apply anti-corrosion agents	Maintenance
Lifting unit - collar	Visual inspection	Maintenance
Forming die, sealig die	Test	Maintenance
Light barriers	Clean	Operator
Multiprint printer	Clean guide roller and deflection rollers	Operator
Discharge conveyor	Tensioning the belt	Maintenance

Service Interval	Service Task	Who
1000 hr / 6 Monthly		
Vacuum pump	Chaning the oil and oil filter	Maintenance
Activate charcoal filter for compresse	Replacement	Maintenance
Maintenance Unit Filter	Replacement	Maintenance
Web advance	Checking and correcting work length	Maintenance
Imprinter	Cleaning and lubricating the guides and rollers	Maintenance

Critical items for the thermoformer were made mostly of consumables which are essential for the desired performance level of the machine. Other items which have been found to be critical as per the RCM worksheet is also included in the critical spare parts list. The spare parts list budget was estimated to be 8 % of acquisition cost ($680K) which is $ 54K. In addition to the spare parts, an estimation was also prepared for proposed TPM plan.

Budget for labour requirements for R145 was calculated using an average base hourly rate of $35 for in-house maintenance works and $100/hour for external service by OEM. Two service kits of $12K each was allocated for the 6 monthly external service bringing a total value of $24K for external service. Additionally, this budget was recommended to be allocated based on coming year's sales value.

K = (Budget) / (Sales) [Eq2]

Next Year Budget value = K × (Forecasted Sales) [Eq3]

Table 9. Critical Spare Budget

Part	Criticality	Number of Units	Unit Price	Current Stock	New Stock	Total Price
Water Valve cooling	2	2	$150	1	2	$300
Main Air inlet valve	3	1	$260	0	2	$520
Brake pad reel brake system	1	1	$479	0	1	$479
Lube Valve Chain lube system	1	1	$367	1	1	$367
Photo Eye register mark	1	1	$471	0	1	$471
station	4	2	$197	1	3	$591
Guide Rods forming station	4	2	$986	1	2	$1,972
Heating Contactor	3	4	$280	1	10	$2,800
Forming plates	2	6	$420	0	1	$420
Lube brush	1	12	$39	2	10	$390
Ventlation valve	3	3	$280	1	2	$560
Evac Oring	4	8	$10	5	7	$70
Evacuation pins	4	6	$25	3	6	$150
Vacuum Pump	4	1	$2,289	1	1	$2,289
Vacuum Hose	4	8	$80	2	4	$320
Sealing Plate	1	1	$980	0	1	$980
Heating Plate	1	1	$879	0	1	$879
Print Head	2	1	$325	1	2	$650
Print Ribbon	2	1	$97	10	10	$970
Lifting Cylinder	3	2	$725	1	2	$1,450
Guide Rods Lifting Cylinder	3	2	$1,028	1	2	$2,056
Cutting Knife	3	3	$326	6	5	$1,630
Drive motor cutting	3	1	$1,765	0	1	$1,765
Slide Bearings forming	2	6	$110	3	6	$660
Pressure Spring	2	2	$80	1	2	$160
Sealing Grid	3	1	$2,268	0	1	$2,268
Forming bottom base	3	1	$2,358	0	1	$2,358
Round Knives	3	3	$387	3	6	$2,322
Serated Knives cutting	3	2	$279	3	4	$1,116
Punching Unit Set	3	3	$254	3	6	$1,524
Linear Cylinder	2	1	$818	1	2	$1,635
Profile Cord	2	15	$50	10	30	$1,504
Sealing Gasket	2	2	$201	4	12	$2,406
Diaphram	2	2	$160	1	2	$319
Toroidal seal	3	20	$49	10	40	$1,946
Throttle valve	2	2	$125	1	2	$251
Gasket set	2	5	$709	1	2	$1,419
Double acting cylinder	3	3	$891	0	1	$891
Guide	3	2	$226	0	2	$451
Steering roller with brake	3	2	$185	0	2	$369
Slide Bearings sealing	3	10	$74	5	20	$1,473
Pressure Spring	3	2	$150	1	2	$301
Forming Grid	2	1	$734	0	1	$734
Sealing bottom base	2	1	$916	0	1	$916
Round Knives squeezing	3	8	$210	8	16	$3,355
Serated Knives forming	3	8	$99	8	16	$1,578
Punching Unit Set deep draw	3	8	$175	6	12	$2,103
					budget	**$54,137**

Table 10. Maintenance Budget for proposed TPM plan

Labor Requirements	Hrs/Year	Men	Labour Cost	Material Requirements	Total
Emergency Repairs (Historical allocation from first year of similar unit)	103	2	$7,210	$5,269	$12,479
Preventive Repairs	260	2	$18,200	$15,687	$33,887
Lubrication	52	1	$1,820	$4,000	$5,820
Condition Monitoring	104	1	$3,640	$8,256	$11,896
Opportunity Maintenance (aprox 2 hours weekly)	104	1	$3,640	$2,569	$6,209
External Service	16	2	$3,200	$24,000	$27,200
				Total	**$97,491**

Maintenance budget was developed using prioritization based on risk. Maintenance activities for each of the 6 substations was planned based on criticality in terms of probability loss of asset function and effect on overall product quality. The probability of loss of function/s, parts availability and impact on quality were estimated using historical data from OEM and production. An overall risk score (Eq 4) criteria was developed as per Table 11.

$$Risk\ Score = (Asset\ probability\ of\ failure)\ X\ (\%\ effect\ on\ quality)\ X\ (Parts\ Availability) \quad [Eq4]$$

Table 11. Risk Score

Risk Score	Risk Value
0.00 – 0.10	1
0.10 – 0.30	2
0.30 – 0.50	3
0.50 – 1.00	4

Activities with risk value of 4 and above were given upmost importance and therefore budget was allocated including emergency repairs and external services. For low risk activities (1 to 3), budget was allocated in line with total risk score.

Table 12 Maintenance prioritizing based on risk

Activity	Asset failure probability	Quality effect	Parts Availabilit	Risk Score	Risk Value	Budget per activity
Emergency Repairs						$12,479
Basic Machine	1.00	1.00	0.80	0.80	4	equals
Forming Station	1.00	1.00	0.80	0.80	4	(20/20)X12479
Sealing Printing	1.00	1.00	0.80	0.80	4	
Cutting Units	1.00	1.00	0.80	0.80	4	
Product Loading	1.00	1.00	0.80	0.80	4	
				Total	20	
Preventive Repairs						$25,415
Basic Machine	0.80	0.40	0.80	0.26	2	equals
Forming Station	1.00	1.00	0.80	0.80	4	(15/20)X33887
Sealing Printing	0.80	0.80	0.80	0.51	4	
Cutting Units	0.70	0.60	0.80	0.34	3	
Product Loading	0.20	1.00	0.80	0.16	2	
				Total	15	
Lubrication						$2,910
Basic Machine	0.50	0.50	0.80	0.20	2	equals
Forming Station	0.50	0.50	0.80	0.20	2	(10/20)X5820
Sealing Printing	0.50	0.50	0.80	0.20	2	
Cutting Units	0.50	0.50	0.80	0.20	2	
Product Loading	0.50	0.50	0.80	0.20	2	
				Total	10	
Condition Monitoring						$5,948
Basic Machine	0.50	0.50	0.80	0.20	2	equals
Forming Station	0.50	0.50	0.80	0.20	2	(10/20)X11896
Sealing Printing	0.50	0.50	0.80	0.20	2	
Cutting Units	0.50	0.50	0.80	0.20	2	
Product Loading	0.50	0.50	0.80	0.20	2	
				Total	10	
Opportunity Maintenance (aprox 2 hours weekly)						$3,725
Basic Machine	0.80	0.50	0.80	0.32	3	equals
Forming Station	1.00	0.50	0.80	0.40	3	(12/20)X6209
Sealing Printing	0.80	0.50	0.80	0.32	3	
Cutting Units	0.70	0.50	0.80	0.28	2	
Product Loading	0.20	0.50	0.80	0.08	1	
				Total	12	
External Service						$27,200
Basic Machine	1.00	1.00	0.80	0.80	4	equals
Forming Station	1.00	1.00	0.80	0.80	4	(20/20)X27200
Sealing Printing	1.00	1.00	0.80	0.80	4	
Cutting Units	1.00	1.00	0.80	0.80	4	
Product Loading	1.00	1.00	0.80	0.80	4	
				Total	20	
				Total Budget		$77,677

Organizational culture was identified as an important factor in implementing TPM. Barriers observed were [15]:

- Behavioral barriers
- Technical barriers
- Human and Cultural barriers
- Strategic barriers
- Operational barriers

4. CONCLUSIONS

There were issues in the Meat processing plant that OEE targets were not meant. In this study SMED technique is applied to critical assets requiring lengthy changeovers. TPM is applied in key areas of the business, thermoforming and packaging. Data collected from fifty-two weeks of production has been analysed and recommendations are made to achieve OEE targets. RCM is being implemented to optimize OEE by reviewing maintenance requirements and prioritizing maintenance based on risks. No immediate changes have been proposed to the cleaning and sanitation processes due to its complexity. Any improvements with the washdown processes will be done in conjunction with the Quality Assurance Department. This study resulted in significant improvement of OEE by reducing wastes and further enhancing productivity and quality and is being rolled out into entire plant.

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